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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Min-Lung Huang

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EXAMINER

KALAM, ABUL

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/820,855	Applicant(s) HUANG, MIN-LUNG	
	Examiner Abul Kalam	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 February 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4, 6, 7 and 25-30 is/are pending in the application.
 4a) Of the above claim(s) 25-30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6 and 7 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on February 26, 2008, has been entered.

Election/Restrictions

2. Newly submitted claims 25-30 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons:

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 25-30, drawn to a method of manufacturing an under bump metallization structure, classified in class 438, subclass 614.
- II. Claims 1-4, 6 and 7, drawn to a under bump metallization structure, classified in class 257, subclass 751.

The inventions are distinct, each from the other because of the following reasons:

Inventions Group I and Group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the product as claimed in claim 1, can be made by another and materially different process than what is claimed in claim 25,

such as forming a second barrier layer on the wetting layer, wherein a part of the second barrier layer comprises tin and another part of the second barrier layer comprises nickel.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Applicant is advised that the reply to this requirement to be complete must include an election of the invention to be examined even though the requirement be traversed (37 CFR 1.143).

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 25-30 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. **Claims 1-4, 6, 7 and 25-30** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Applicant's Admitted Prior Art (AAPA)** in view of **Andricacos et al. (US 6,224,690; previously cited)**.

With respect to **claim 1**, **AAPA** teaches (**pg. 2: [0004]-[0005]**) an under bump metallization structure (**FIG. 1**) applicable to be disposed on bonding pads (**104**) of a semiconductor wafer (**101**), wherein a passivation layer (**102**) covers the wafer and exposes the bonding pads (**104**), the under bump metallization structure (**106**) comprising:

- an adhesive layer (**106a**) formed on the bonding pads (**104**);
- a first barrier layer (**106b**) disposed on the adhesive layer (**106a**); and
- a wetting layer formed (**106c**) on the first barrier layer (**106b**).

Thus, **AAPA** teaches all the limitations of the claim with the exception of disclosing: a second barrier layer disposed on the wetting layer wherein a material of the second barrier comprises tin and nickel.

However, **Andricacos** teaches a under bump metallization structure (**FIG. 4**), wherein a second barrier layer comprising nickel and tin (**col. 5: Ins. 26-32: "Ni film" and "nickel-tin intermetallic"**) is disposed on the wetting layer (**Cu**).

With respect to **claim 2**, **Andricacos** teaches wherein the quantity of the tin is smaller than the quantity of the nickel (**this is implicit because Andricacos states that although a nickel-tin intermetallic is formed, the under bump metallization does not spall off; furthermore, reaction of the solder with the underlying copper is prevented; col. 5: Ins. 26-32**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of **AAPA** with the teaching of **Andricacos**, to form a barrier layer on the wetting layer of copper, for the purpose of increasing

adhesion and preventing the reaction of the solder with the underlying copper, and thus, improving the reliability of the device by preventing the spalling of the under bump metallization layer (**col. 5: Ins. 26-32**).

With respect to **claim 3, AAPA and Andricacos** teaches the under bump metallization structure of claim 1, as set forth above. Furthermore, **AAPA** teaches wherein the first barrier layer comprises nickel-vanadium or nickel (**pg. 2: [0005]**).

With respect to **claim 4, AAPA and Andricacos** teaches the under bump metallization structure of claim 1, as set forth above. Furthermore, **AAPA** teaches wherein the wetting layer is a copper layer (**pg. 2: [0005]**).

With respect to **claim 6, AAPA and Andricacos** teaches the under bump metallization structure of claim 1, as set forth above. Furthermore, **AAPA** teaches wherein the adhesive layer comprises titanium (**pg. 2: [0005]**).

With respect to **claim 7, AAPA and Andricacos** teaches all the limitations of the claim, as set forth above in claim 1, with exception of explicitly disclosing: wherein the thickness of the second barrier layer is ranged from about 50 μm to about 80 μm .

However, note that it is not inventive to discover optimal or workable ranges by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955). Furthermore, where patentability is based upon a particular chosen range or dimension recited in the claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have a thickness of the second barrier layer in such a range as claimed, because the range is not critical since it can be optimized during routine experimentation, depending upon the desired conductivity the second barrier layer.

Response to Arguments

4. Applicant's arguments with respect to claims 1-4, 6 and 7, filed February 26, 2008, have been considered but are not persuasive.

With respect to claim 1, Applicant argues that although "other portions of the Andricacos reference are cited as allegedly disclosing a second barrier layer comprising tin and nickel, these portions are ambiguous and confusing as compared to the clear statement at col. 5, lines 5-8 of Andricacos regarding the teaching of a solder/barrier layer. The argument is not persuasive. The "other portions" that the Applicant is referring to is col. 5, lines 25-31, wherein Andricacos clearly states that "a nickel-tin intermetallic is formed," and that this intermetallic "prevents the reaction of the solder with the underlying copper." There is nothing confusing or ambiguous about these statements. Thus, Andricacos discloses a second barrier layer comprising tin and nickel.

Applicant also argues that the nickel-tin intermetallic is a compound, and thus, "the nickel-tin intermetallic is not only chemically different from tin and nickel, but also different from the tin-nickel alloy." The argument is not persuasive. First, claim 1 does not limit the second barrier layer to a "tin-nickel alloy," but only recites that the second

barrier layer comprises tin and nickel. Second, one skilled in the art would clearly recognize that a nickel-tin compound is comprised of both nickel and tin. Furthermore, it is noted that the arguments of counsel cannot take the place of evidence in the record. *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); *In re Geisler*, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997). Attorney statements are not evidence and must be supported by an appropriate affidavit or declaration. See MPEP 716.01(c). The examiner recognizes that a nickel-tin intermetallic compound contains both nickel and tin. Therefore, if Applicant still believes that a nickel-tin intermetallic compound does not comprise nickel and tin, then Applicant is requested to support that position with facts.

Applicant also argues that "the intermetallic layer formed as the result of the consumption of the solder layer as reading on the claim limitation of a barrier layer is inaccurate and incorrect." The argument is not persuasive. Note that claims are given broadest reasonable interpretation, and thus, any layer formed between two other layers or materials is considered a barrier layer. Furthermore, note that claim 1 is drawn towards a structure and not a method of manufacturing, and thus, it is the final structure of the device which is given consideration and patentable weight.

Applicant also argues that "the fact that the nickel solder layer (and not the subsequently formed intermetallic layer) is disclosed in Andricacos as the means for preventing the reaction of the solder with the underlying copper means that the motivation statement set for the Official Action is improper." The argument is not persuasive. First, Applicants arguments are not considered "facts" and cannot take the

place of evidence in the record. *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); *In re Geisler*, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997). The examiner recognizes that both the nickel layer and the nickel-tin intermetallic prevents the reaction between the solder and the underlying copper. If the nickel-tin intermetallic did not form, the solder would simply diffuse through the nickel layer and into the copper layer.

Applicant also argues that there "must be positive benefit associated with the modification to provide motivation for the proposed modification." The argument is not persuasive. Preventing spall off and increasing adhesion are both positive benefits that would improve the reliability and lifetime of the device.

With respect to claim 2, Applicant argues "that a barrier layer having less nickel than tin will still provide nickel for the solder to react with and promote adhesion of the solder to the underlying structure." The argument is not persuasive. Applicant has not provided any factual evidence to support such an argument. Furthermore, the argument is illogical. How can a barrier layer with less nickel than tin, provide nickel for the solder to react with? The excess tin would just diffuse into and react with the underlying copper layer. In *Andricacos*, the tin from the solder is reflowed onto the nickel layer such that a nickel-tin intermetallic is formed, and thus, prevents the reaction of the solder with the underlying copper (col. 5, lns. 13-31). Note that while the Office has provided an example (US Pat. No. 6,744,142) of a nickel-tin intermetallic with greater amount of nickel than tin, the Applicant has not provided any factual evidence to

support their argument that “the amount of nickel in a nickel-tin barrier layer can be higher or lower than the amount of tin and still serve as barrier layer.”

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Abul Kalam whose telephone number is (571)272-8346. The examiner can normally be reached on Monday - Friday, 9 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. K./
Examiner, Art Unit 2814

/Phat X Cao/
Primary Examiner, Art Unit 2814

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